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REPORT

OF

The Lake Erie and Ohio River Canal Board

OF PENNSYLVANIA

FILED, JUNE 28, 1917

WITH

HON. MARTIN G. BRUMBAUGH

Governor of Pennsylvania

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R E P O R T
O F
The Lake Erie and Ohio
River Canal Board
OF PENNSYLVANIA

JUNE, 1917

B Y

WILLIAM H. STEVENSON, President;

JOHN E. SHAW,

WILLIAM U. FOLLANSBEE,

THOMAS P. SLOAN,

A. E. ADAMS,

H. C. OGDEN.

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REPORT OF THE LAKE ERIE AND OHIO RIVER CANAL BOARD OF PENNSYLVANIA

The Lake Erie and Ohio River Canal Board of Pennsylvania, appointed in 1915 by the Governor of Pennsylvania under Acts of the Legislature of June 27th, 1913, and June 17th, 1915, to locate, construct, maintain and operate a navigable interstate canal or waterway from the junction of the Ohio and Beaver rivers in the State of Pennsylvania to a terminus on Lake Erie at or near the mouth of Indian creek in the State of Ohio and which was directed by said Acts, as soon as there was appropriated to its use sufficient funds, to prepare or cause to be prepared a survey for the said canal, together with estimates of cost of constructing it, exclusive, however, of the cost of building a harbor at Lake Erie and to make report of all its operations, hereby reports:

THAT it has made an exhaustive investigation of all important matters connected with the canal project. It has reviewed and revised the work of its predecessor Board appointed under the Act of 1913.* It has had the assistance and advice of the eminent and well-known hydraulic and waterway engineers, Isham Randolph and Frederic P. Stearns, who were members of the Panama Canal Advisory Board of Engineers; John P. Newton, hydraulic engineer, and George F. Stickney, assistant constructing engineer of the New York-Erie Barge canal, as well as its own chief engineer, George M. Lehman, and also of Dr. John T. Holdsworth, Dean of the School of Economics of the University of Pittsburgh. It has had the advantage of data collected during a period of years by public and private commissions, companies and associations interested in the subject prior thereto. It has held numerous meetings and made trips of investigation to other canals and personal inspection of the route of the Lake Erie and Ohio River canal.

*This Board was composed of Wm. A. Magee, ex-Mayor of Pittsburgh, president; Colonel Thomas W. Symons, U. S. Engineer, retired; Thomas P. Sloan, A. S. McSwigan and James A. Chambers. It was appointed May 27, 1914, and served until May 20, 1915. Under its auspices much valuable work was done.

As a result of its investigations the Board finds:

FIRST:

The proposed canal is feasible from an engineering standpoint; it presents no difficult physical problems; there is an abundant water supply and it can be constructed for a sum of money the expenditure of which is justified by existing traffic needs and conditions.

SECOND:

The route of the canal should be as follows:

Beginning at the mouth of the Beaver river in the State of Pennsylvania and running thence in the channel of said river 20.7 miles to the junction of the Mahoning and Shenango rivers; thence in the channel of the Mahoning river 29.4 miles to Niles, Ohio, with only such departures from said river channels as are necessary to eliminate unnavigable curves; thence following generally the valley of Mosquito creek about 8.4 miles to a point in Trumbull county, approximately 2.5 miles southwest of the village of Cortland, Ohio, which point is the southerly limit of the summit level of the proposed canal; thence in a course almost due north across said summit level a distance of 27.3 miles to a point about 2 miles east of Rock creek, Ohio, which point is the northern limit of the summit level; thence by the valleys of Grand river and Indian creek about 15.7 miles to a point at or near the mouth of Indian creek on Lake Erie, approximately $6\frac{1}{2}$ miles west of Ashtabula; making the total length of the route $101\frac{1}{2}$ miles.

On this route the elevation to be ascended from the mouth of the Beaver river to the summit level is 232 feet, and the descent from the summit level to the lake 327 feet.

The number of locks required will be 26, with lifts of from 10 to 30 feet.

THIRD:

The canal should be not less than 12 feet deep, with locks 56 feet in width by 400 feet in length, with depth of 12 feet over miter sills. The bottom width of the canal should be not less than 140 feet and its surface not less than 188 feet.

FOURTH:

The cost of this canal at prices prevailing in 1914-1915 is estimated to be \$65,000,000, and its capacity 38,000,000 tons per annum. This estimate of cost does not include branches to New Castle, Pennsylvania and Warren, Ohio, each of which will cost roughly \$3,500,000.

FIFTH:

The proposed canal connects the two largest inland waterways in the United States and traverses a district through which there is a tonnage movement greater than that of any other district of equal area in the world.

SIXTH:

The canal will be able to carry iron ore, coal and other heavy materials at an estimated cost of about 50% of the present railroad rates.

SEVENTH:

Additional transportation facilities between the Ohio river and Lake Erie such as the canal would provide are badly needed to prevent congestion and obstruction of railroad traffic.

EIGHTH:

The canal will furnish the last deep waterway link necessary to connect the iron ore fields of Minnesota and Michigan with the coal fields of Western Pennsylvania, West Virginia and Ohio and the Harbor of Pittsburgh with those of Chicago, Cleveland, Toledo, Detroit, Milwaukee, Duluth and Buffalo on the Great Lakes, and with those of New York, Philadelphia, Baltimore and other Atlantic ports, and give the Pittsburgh District deep waterway connection with twenty-seven states and Canada.

NINTH:

It will promote the cause of National defense and preparedness by providing a safe means of transporting small war vessels and munitions of war between the Mississippi valley, the Great Lakes and the Atlantic coast.

TENTH:

It will materially assist the canal district to retain and increase its existing iron, steel and coal trade, as well as attract new and more varied industries.

ELEVENTH:

The canal reservoirs will conserve flood waters of important tributaries of the Allegheny and Ohio rivers, and improve the navigation of these rivers in time of drought, and so supplement and fit in with the works of the Flood Commission of Pittsburgh.

TO JUSTIFY THESE CONCLUSIONS THE BOARD
SUBMITS THE FOLLOWING HISTORY
AND EVIDENCE:

The idea of connecting the Ohio river and Lake Erie by an artificial waterway was originated by George Washington more than a century ago. He desired to connect the tidewaters of Virginia with a canal to extend from the Potomac river to the Ohio river and thence continue to Lake Erie. He made a careful study of the subject and decided that the best route for the Lake Erie and Ohio River canal was much the same as that now recommended by this Board.

Between 1830 and 1840 the Ohio river was connected with Lake Erie by several towpath canals, the principal one being the Pennsylvania-Erie canal, beginning at the mouth of the Beaver river and following it to the mouth of the Shenango river; thence in the Shenango to the latter's source and thence across country to Erie Harbor. This canal was from four to six feet deep. It was operated successfully for a number of years and then supplanted by railroads. It was connected by an east and west branch, or cross-cut canal, with the canal which followed the Muskingum and Cuyahoga rivers from the Ohio river to Lake Erie. Further west was a canal up the Scioto river through Columbus which also reached Lake Erie, and still beyond this to the west was the Miami canal, extending from Cincinnati to Toledo.

The railroads acquired control of the Pennsylvania-Erie canal and permitted it to fall into disuse. There were several reasons for this: One that the canal was small; another that at one point it ran over quicksands, which caused leakage of water that the engineering skill of that day could not cope with; a third was that at that time the Ohio river from the mouth of the canal at Beaver to Pittsburgh was unimproved.

The rates charged on this canal were low, coal being transported for about 50 cents a ton.

In 1889, Andrew Carnegie, desiring to lower the cost of transportation between the Pittsburgh District and the lake, induced the Pennsylvania Legislature to appropriate \$10,000 for the investigation of the feasibility of a deep canal, commonly called at that time a ship canal, although Mr. Carnegie himself contemplated only the use of barges. A survey was made and a feasible route found which followed the Beaver and Shenango rivers to near Greenville and thence overland to the harbor at Conneaut, Ohio, on Lake Erie.

Owing to the fact that the route was not entirely through Pennsylvania and that some readjustment of railroad rates was made at the time, the project was dropped. In 1894-1895 the Pittsburgh Chamber of Commerce revived the matter and appointed a provisional ship canal committee. This committee raised and expended \$50,000 in making a survey. This survey located a route along the Beaver and Mahoning rivers to Niles, Ohio and thence by the valley of Mosquito creek and overland to Ashtabula, Ohio.

About this time the Pittsburgh, Bessemer and Lake Erie Railroad was built and, as this promised to relieve freight congestion between Pittsburgh and the Lakes and also to reduce railroad rates, the canal project was again dropped. In 1905 it was again taken up by the Merchants and Manufacturers' Association of Pittsburgh, with the result that the Lake Erie and Ohio River Ship Canal Company was organized to build and operate the waterway.

This company expended \$60,000 for surveys and investigations and reported favorably on the project, but, owing to the financial panic of 1907, was unable to secure the funds necessary to carry it out.

Shortly after the discontinuance of activity by this company public sentiment favorable to increasing public control of all public utilities commenced to develop and the Lake Erie and Ohio River Canal Association was formed for the purpose of constructing the canal with public funds. These funds were to be obtained from the counties bordering on the canal and the waterways connecting with it and from the States of Pennsylvania, Ohio and West Virginia and the National Government.

This Association secured the legislation in the three states necessary to enable it to proceed and also a report from the National Waterways Commission favorable to the undertaking.

Under the legislation thus obtained the present Canal Board and its predecessor were appointed.

The legislation which created these Boards defines the Canal District as an area which embraces all the counties of Pennsylvania, Ohio and West Virginia situate on the canal or on the waterways connected with it. This definition construed in its widest sense would include about 58 counties and in its narrowest about 38 counties.

The population of the 58 counties is about 5,000,000, and of the 38 counties about 3,500,000. The assessed valuation of the 58 counties is about \$5,200,000,000, and of the 38 counties about \$3,500,000,000.

The chief industries of most of these counties are iron and steel manufacturing and bituminous coal mining.

PRINCIPAL QUESTIONS DETERMINED.

The principal questions considered by the Board in arriving at the conclusions heretofore stated were:

- First: Is the canal feasible?
- Second: What is the most desirable route?
- Third: What should be the dimensions of the canal and its locks?
- Fourth: What will it cost?
- Fifth: Is its construction desirable and necessary?
- Sixth: Will it yield a proper return for the money it costs?
- Seventh: The type and speed of boats.
- Eighth: The authorities relied upon for the conclusions arrived at.

FEASIBILITY.

- First: Is the canal feasible?

This naturally divides itself into two parts:

- (a) Are there any insurmountable engineering difficulties in the construction of the canal and its feeders?
- (b) Is there a sufficient water supply?

(a) The proposed waterway will consist almost equally of canalized rivers and artificial canal. At only three or four points in the canalized portion is it necessary to depart from the channels of the rivers followed and then only for short distances to straighten out curves. A considerable portion of the Beaver river, about 8 miles, is deep enough for canal purposes without dredging. The rise to be overcome between the Ohio river and the junction of the Mahoning and Shenango near Lawrence Junction is 88 feet. This rise will be cared for by six locks.

Between Lawrence Junction and Niles, Ohio, a distance of about 30 miles, three or four cut-offs must be made to straighten

out the channel of the Mahoning river. This river will have to be deepened and six locks built. The rise from Lawrence Junction to Niles is about 83 feet.

NO ENGINEERING DIFFICULTIES.

There are no engineering difficulties to be encountered either in straightening or deepening the Beaver and Mahoning rivers between the Ohio river and Niles or in constructing the locks. The character of the dredging to be done has been investigated.

At Niles the artificial canal begins, but even here Nature has helped by providing the valley of Mosquito creek, which is followed for 8.4 miles to the southern end of the summit level. Three locks are required between Niles and the summit level, the elevation to be surmounted being 61 feet. The excavating to be done in this section is work of a simple character, and so also is the construction of the locks.

The summit level is 27.5 miles long, and for this distance no locks will be required. The character of the geologic formation is such as to make the canal construction comparatively easy. The lock and dam at the southern end of this summit level will create a lake nearly 1 mile wide and $9\frac{1}{2}$ miles long, for eight miles of which no dredging will be required. Through this lake the boats can go at maximum speed.

From the northern end of the summit level the canal will descend to Lake Erie. Here again, Nature has eased the way. The valleys of the Grand river and Indian creek will be followed.

The distance from the northern end of the summit level to Lake Erie is 15.7 miles and the fall is 327 feet. There will be 11 locks with a lift of about 30 feet each and the work of building them will be free from material engineering difficulties. Greater difficulties have been for years successfully surmounted on the Welland canal, which, in Canada, connects Lake Erie with Lake Ontario a few miles from the mouth of the Niagara river.

The Welland canal in its descent from the summit level to Lake Ontario has a fall of 326 feet, or within one foot of that of the descent of the Lake Erie and Ohio River canal from the summit level to Lake Erie. In the case of the Canadian waterway the descent has to be made in less than seven miles, while in the American one about 16 miles can be utilized. The Welland canal originally had 27 locks to make the descent, but the new ship canal now being built by the Canadian Government will have only seven

locks, each of 42 feet 6 inches lift. The Welland canal's total cost will exceed that of the Lake Erie and Ohio River canal and it will have much less tonnage to draw upon.

The New York-Erie Barge canal, which is to be opened next year, will have the same depth as the proposed Lake Erie and Ohio River canal. The New York canal and its branches have a length of over 500 miles as against only 101.5 miles and 55 locks as against 26 locks for the Lake Erie and Ohio River canal.

WATER NEEDS OF THE CANAL.

(b) On the basis of a carrying capacity of 38,000,000 tons per annum, the amount of water which will be required to operate this canal will be not more than 8,000,000,000 cubic feet per annum.

If the canal were to be provided with double locks its carrying capacity would be 76,000,000 tons per annum, and the water required would be not more than 14,000,000,000 cubic feet. (The Board does not recommend double locks at this time.)

These figures are based upon a navigation season of eight months.

SOURCES OF WATER SUPPLY.

The sufficiency of the water supply for the type of canal contemplated in this report has been most thoroughly investigated by this Board.

In addition to the investigations carried on by the engineer of the Board, George M. Lehman, who spent a long time studying the extent of the water sheds and rainfall in the territory near to the higher levels of the proposed canal and all the available data relating thereto, the Board secured the services of John P. Newton, water supply engineer of the New York Barge canal. Mr. Newton spent at least a year thoroughly inspecting the French creek and adjacent territories and the data concerning the same, embodying his researches in a report submitted to this Board early in May, 1916. Both Mr. Newton and Mr. Lehman found that an abundance of water for the use of this canal could be secured from the French creek drainage section, and outlined a plan of conservation.

Later this Board employed Isham Randolph, of Chicago, an engineer of national reputation, who checked Mr. Newton's report and confirmed his findings. Mr. Randolph said in his report:

"I know of no great public improvement that has received the careful, comprehensive study that has been given to the proposed Lake Erie and Ohio River canal" and

"Enough water is available to meet the greatest prospective traffic through this canal" and again

"There is water enough and to spare for every need of the canal up to the maximum demand upon it."

Still further to assure itself of the sufficiency at all times of the water supply in the territory adjacent to the upper canal levels, this Board secured the services of Frederic P. Stearns, consulting engineer of the Water Supply Commission of Pennsylvania, one of the most eminent waterway engineers of America. Mr. Stearns had the advantage of having made an entirely independent study of the French creek and adjacent territories in connection with his work on the proposed Pymatuning Swamp reservoir. His investigations for this Board were carried on with a view of determining the possibility of securing an abundant water supply for the canal and at the same time assuring a sufficient quantity of water in the upper reaches of the Shenango river to meet the industrial and other demands of the Shenango valley, particularly those of the manufacturing plants of Sharon and New Castle.

SUFFICIENT WATER ASSURED.

As a result of his investigations, Mr. Stearns reports that by the plans adopted by this Board and slight modification of the plans made by Mr. Lehman and Mr. Newton, not only can sufficient water be secured for the use of the canal, but the water supply of the Upper Shenango valley can be largely augmented and the manufacturing facilities of that section be thereby improved.

The conclusions of Mr. Stearns embodied in his report, confirming as they do the individual investigations carried on by Engineers Newton and Lehman and approved by Engineer Randolph, put beyond all question the sufficiency of the available water supply. Mr. Stearns' conclusions are stated so succinctly and comprehensively that they are quoted in full:

"The feature which stands out most prominently as the result of the investigations is that if the two projects under consideration are to be carried out (namely, the construction of the canal, and the improvement of the Shenango valley water supply), there should be co-operation by those in charge. It is very desirable, if not essential, that the supply of water for the Lake Erie and Ohio River canal should be chiefly French creek water stored in an enlarged Pymatuning reservoir, and if the additional works for the purpose are sufficiently ample the regulation of the Shenango and Beaver rivers can be more satisfactorily accomplished by the joint works than with independent works. The estimated cost of the joint project would be much less than the total cost of two independent projects.

"The 13,930 million cubic feet of water estimated to be required for canal uses during each navigation season, if the canal is given the largest of proposed dimensions and double locks, can be obtained from French, Mill and Mosquito creeks if sufficient storage capacity is provided in the Pymatuning reservoir and elsewhere.

"Works which will provide, during the driest periods and with a large margin for contingencies, the above quantity of water for canal uses and all the water required for maintaining a discharge of 450 cubic feet per second in the Shenango river consist of:

"Reservoir A, on French creek, with a capacity of 2,130 million cubic feet.

"Diversion dams across French and Cussewago creeks, about 2.5 miles above Meadville, with an interconnected reservoir of moderate size above them.

"A feeder about 20 miles long from a diversion dam at French or Cussewago creek to the Pymatuning reservoir, having a winter capacity of 1,000 cubic feet per second, and a summer capacity of 1,200 cubic feet per second.

"The Pymatuning reservoir, having an area of 39.35 square miles, with a capacity of 19,440 million cubic feet, of which 18,000 million cubic feet will be available.

"A feeder about 14 miles long leading from the Pymatuning reservoir to the head of a reservoir on Mill creek, having a capacity equal to the canal demand.

"A reservoir on Mill creek, having an available capacity of 460 million cubic feet.

"A feeder about 11 miles long leading from this reservoir to the summit level of the canal.

"The discharge of French creek in the driest years is far in excess of the quantity which can be utilized by the plan described, and much more of the water can be made available by providing additional reservoirs upon the main stream and its tributaries.

"It is also feasible to provide additional drainage area and storage on Pymatuning creek, thus furnishing additional available water, and it is probably feasible to build the Pymatuning reservoir to a higher level, thus utilizing more of the waters from French creek by storing it in this reservoir.

"There are so many opportunities for supplementing the supply in the ways indicated as to leave no doubt that canal demands far in excess of those now estimated can be met with a reasonable expenditure of money."

The Board strongly approves of Mr. Stearns' suggestion for co-operation between it and the people of the Shenango valley who are interested in providing a sufficient, reliable supply of water for their needs, and believes that when the Pymatuning reservoir is undertaken it should be constructed with a view of ultimately supplying not only those needs, but also those of the canal.

ROUTE OF THE CANAL.

The second question, "What is the most desirable route?" has been largely answered in the reply made to the first question. The route selected and heretofore described was chosen for four principal reasons:

First: It is the shortest feasible one between the Ohio river and Lake Erie.

Second: It traverses the lowest elevation of land between the Allegheny mountains and the Miami river.

Third: It runs through the largest tonnage producing district in the world and

Fourth: The Beaver and Mahoning rivers, portions of which are already navigable, afford an available channel for one-half of the whole length of the canal, while the streams and valleys of Mosquito creek, Grand river and Indian creek cover much of the remainder of the route.

At Indian creek the Government is expected to build the necessary harbor and also to deepen the Ohio from Pittsburgh to Beaver to twelve feet.

The National Waterways Commission, of which Hon. Theodore Burton was chairman, examined this route in 1912 and recommended that the Government build the canal harbor at Lake Erie, deepen the harbor at Pittsburgh and lend United States engineer officers, if desired, to supervise the work of building the canal proper.

The chief of engineers of the United States army, General W. M. Black, has recently recommended replacing of the Davis Island dam and Dam No. 2 (movable dams), on the Ohio river below Pittsburgh, with one fixed dam providing for a depth of twelve feet.

CANAL AND LOCK DIMENSIONS.

In answer to the third question, "What should be the dimensions of the canal and locks?" the Board is of the opinion that the canal should be built with a bottom width of 140 feet, a depth of 12 feet and single locks 56 x 400 feet, 12 feet over sills.

The competent engineers who have carefully investigated this question find that a canal of this type will have a capacity of 38,000,000 tons annually. It is the opinion of the Board that, if the canal is to meet the needs of this community it should be able to carry without difficulty from 20,000,000 to 30,000,000 tons annually, and provision should be made for a large expansion of that capacity. By the simple process of widening the bottom from 140 to 180 feet and by providing double locks instead of single locks the annual capacity of the canal can be increased from 38,000,000 to 76,000,000 tons.

In fixing the depth of 12 feet and the bottom width at 140 feet the Board has been influenced by two considerations:

First: Because these dimensions appear to be the most advisable and economical for the character of canal primarily contemplated. Such a canal would for some time have sufficient capacity to properly carry much of the heavier and bulkier materials used or manufactured in the great industrial section it traverses and, as above indicated, could easily be enlarged when necessary.

Second: The New York Barge canal, extending from the Hudson river to Lake Erie and now nearing completion, has a depth over sills of 12 feet. With the completion of the Lake

Erie and Ohio River canal, following the completion of the New York Barge canal, a waterway of uniform depth will be created from the Ohio river to the Hudson, and the interchange of traffic between these two great waterways and their tributaries will thereby be enormously facilitated.

AS TO THE COST OF THE CANAL.

The fourth question is: "What will the canal cost?" The estimates of cost which follow below were made by competent engineers of high standing. They have been checked and rechecked several times by other competent engineers. They probably are as near exactly correct as any such estimates can be made. They were made in 1914-1915 before prices had been increased by the European war and so must be revised if the canal is built before prices again become normal. They do not include interest accruing on bonds during the period of construction. Such interest, if any, can only be estimated when the method of financing and the terms and conditions of the bonds to be issued are known, and these matters will not be finally decided until the question of building the canal is submitted to the voters. A rough calculation might perhaps be made, but the assumptions involved in such a calculation would necessarily be so numerous that it would be meaningless.

The costs of six different types of canal have been figured, but only that of the particular type of canal recommended by the Board is quoted in this report.

This for the main line of the canal with its necessary feeders and reservoirs will be, as has been stated, about \$65,000,000.

In addition, the cost of the branch to New Castle will be about \$3,500,000, and of the branch to Warren about the same. These branches will be valuable adjuncts to the canal and should be built at the same time.

This estimate of \$65,000,000 for the main line is made up of the following items, round numbers being used:

ESTIMATED COST

Canal, Mouth Beaver River to Indian Creek (101.5 Miles).

	Quantity.	Amount.
Land	12,380 Acres	\$ 1,995,000
Damages		2,950,000
Excavation, Earth	29,479,800 Cu. Yds.	6,725,000
Rock	4,230,000 Cu. Yds.	9,600,000
Embankment	3,572,600 Cu. Yds.	540,000
Slope Paving.....	450,000 Sq. Yds.	564,000
Dams, Fixed	1	
Bear Trap	2	
Bridge	9	1,880,000
Locks	26	14,300,000
Guard Gates	3	125,000
Spillways, Culverts, Aqueduct...		1,200,000
Retaining Walls		1,050,000
Terminals	16	2,650,000
Bridges, Railroad	30	2,640,000
Highway	59	1,350,000

Total.....	\$47,569,000
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Water Supply.

French Creek Feeder	\$ 3,170,000
Mill Creek Feeder.....	1,250,000
French Creek, Reservoir A.....	950,000
Land, Reservoir AA (Cussewago) and Additional Land for Bemus Dam.....	245,000
Pymatuning Reservoir F, if Constructed for Canal Needs Only	2,862,000
Mill Creek Reservoir I.....	150,000

Total.....	\$ 8,627,000
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Canal, Mouth Beaver to Indian Creek.....	\$47,569,000
Water Supply	8,627,000

\$56,196,000

Engineering and Contingencies.....	8,429,400
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Total cost.....	\$64,625,400
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IS THE CANAL NECESSARY?

The fifth question considered was: "Is the canal absolutely necessary and desirable?"

Strenuous and long-continued efforts have been made to bring about a reduction of the railroad rates on iron ore and coal, but without appreciable results. These rates, through action of the Interstate Commerce Commission in 1915, were fixed at 88 cents for iron ore from lake ports to the Pittsburgh district and at 78 cents on cargo coal from the Pittsburgh district to lake ports, a reduction of 8 and 10 cents, respectively, from the figures which had long prevailed.

At the same time the rate on ore to the Wheeling district was increased to correct a discriminatory rate which had prevailed for a number of years. This reduction on iron ore and cargo coal has been more than wiped out by the recent increase of 15 cents per ton. The same will prove true as to the local coal if a like increase of 15 cents now scheduled to take effect on July 1st, 1917, is allowed by the Interstate Commerce Commission.* The railroads testified some years ago before the Interstate Commerce Commission that the actual cost to them of carrying iron ore was 62 cents a ton from the lake to the Pittsburgh district. Since then the cost has increased, and it is common knowledge that railroads generally must be allowed to advance rates in almost all lines and districts if they are to properly meet the demands for extension that the rapid growth of business is laying upon them. The canal will substantially augment the facilities of the district, and the Board's investigations leads it to the belief that it also will materially reduce transportation charges, sufficiently, in fact, to place the canal district on an equality with all its important competitors and assure its continued supremacy in iron and steel manufacture.

CANAL TOLLS AND OTHER CHARGES.

The canal at the outset, it is calculated, will charge for toll between the Pittsburgh district and the lake about 31 cents per ton on ore, 26 cents per ton on coal and 62 cents per ton on miscellaneous freight. The shippers will in addition have to pay the vessel charges to the vessel owners, which will not exceed 13.8 cents per ton, and also transfer expenses, which on ore will not exceed 13 cents and not more than 8 cents on coal, and will vary in amount on the miscellaneous freight. The total cost of transportation by canal will not exceed 57.8 cents on ore and 47.8 cents on

*This increase has since been allowed.

coal and 75 cents and transfer charges on miscellaneous freight. The total cost on railroads, if the 15 cents per ton increase on ore and cargo coal is permitted to stand and the proposed similar increase on local coal is allowed by the Interstate Commerce Commission, will be as follows:

On ore direct from ship to furnace, 97 cents; on iron ore first transferred to ore pile at dock and later to furnace, \$1.17, with 1 cent a month per ton for storage period at dock, which averages five months. On coal the rates will be for cargo coal, including 5 cents for transfer, 98 cents, and on local coal \$1.15. One-fifth of the iron ore is stored or docked ore, and fully one-half of the coal is local coal, i. e., it only goes to and is used at lake ports and is not shipped on lakes by vessels as is cargo coal. The average railroad charges for iron ore will therefore be about \$1.02 per ton and for coal \$1.06½ per ton. The railroad rates on miscellaneous freight will be about double those on the canal. When the annual traffic on the canal exceeds 20,000,000 tons, a reduction on tolls will be possible.

Dr. John T. Holdsworth, Dean of the School of Economics of the University of Pittsburgh, after making an exhaustive study of this subject, shows that the supplies of coal in the territory served by the canal and the supplies of iron ore in the Northwest are sufficient to keep the canal busy for centuries to come. Reduction in the cost of coal transportation is calculated to increase consumption within the district itself and also give coal producers opportunities to open up new markets. With the Ohio river improved, the Lake Erie and Ohio River canal constructed and the New York-Erie Barge canal in operation there will be deep water connection between the canal district, the Gulf of Mexico and the Panama canal, twenty-seven states and Canada, and an increase in traffic through the whole district should result.

THE CANAL AND THE RAILROADS.

During the past ten years, and in particular during the years 1916 and 1917, the railroads between the lake and the Ohio river have been unable to handle satisfactorily much of the traffic that has originated in this territory. On many occasions complete or partial embargoes have seriously crippled industries and slow and uncertain service has laid a great tax upon the productive capacity of the entire section. The construction of the canal would enormously supplement present transportation facilities and relieve congestion. The railroad traffic between Pittsburgh and Lake Erie is

increasing at a rapid rate. In the decade ending in 1913 it doubled. It may safely be calculated to go on increasing at a rapid rate.

Railroad facilities have not kept pace with the increase of business and it is yearly becoming more difficult for railroads to meet the demands made upon them. It would be exceedingly difficult to find a route suitable for a new railroad between Pittsburgh and the Great Lakes district and, even if such a route would be found, the cost of terminal facilities would be almost prohibitive.

The canal will have no extensive outlay for terminal facilities. It will serve many industrial establishments on its own banks, or on those of the rivers connected with it.

There are already several hundred establishments on the banks of the Ohio, Monongahela, Allegheny, Beaver, Mahoning and Shenango rivers which can be served by canal barges, and the canal will make sites for additional hundreds available.

CANAL NEEDED FOR NATIONAL DEFENSE.

The canal is desirable from the standpoint of national defense. With it constructed there will be a way opened for small war vessels to go from the Ohio and Mississippi rivers to the Great Lakes and thence over the New York-Erie Barge canal to the Hudson river and New York. Munitions of war could be moved between the Gulf of Mexico, the Mississippi valley and the Atlantic coast by water in the event of congestion or stoppage of railroad traffic from any cause.

In this period of war the canal would have been a most valuable national asset.

In the judgment of this Board the construction of this canal will not impair the business or reduce the revenues of the railroads now operating between the Ohio river and the lakes. These railroads are now overtaxed. Their equipment is strained to the utmost to handle existing traffic. This traffic will greatly increase as time goes on, and the canal will naturally carry only the heavier and bulkier freight, which is carried at the lowest rates. The railroads will thereby be released to carry the higher, costlier and more perishable freight, and the growth of population and industry will soon make this class of freight enormously profitable. The Board recognizes the fact that these railroads perform an indispensable public service. They are owned by the general public and they are entitled to most careful consideration, but in view of the existing conditions it is the belief of the Board that long before this canal can be completed there will be ample business for both the canal and the railroads, and indeed, perhaps, more than both together can handle.

It has been the uniform experience of all the districts that have developed improved water transportation facilities that the business of the railroads has been bettered rather than injured.

THE CANAL'S PROFITS.

The sixth question was: "Will the canal yield proper returns on the money invested?"

Concerning such returns this Board believes not only that the canal is an economic necessity and will be indirectly profitable through decrease in transportation costs and increase in general prosperity and growth of the district, but also that it in time will be directly profitable through earnings on its cost realized from tolls charged on the traffic it may carry.

Eventually, if not immediately, the advantages of the canal will be recognized and a large tonnage will be carried upon it.

In the long run a carrier that is really economical is certain to be used largely, and we believe there is no question as to the ability of the canal to carry bulky freight at a lower cost than any existing carrier and in all probability at a lower cost than any other carrier that can be created in many years.

The world's experience is that modern water and rail transportation agencies co-operating provide the facilities best calculated to meet the transportation needs of the productive community and that each is of itself a real necessity.

The size and capacity of the canal are in keeping with the growing needs of the industries of the canal section and, in spite of the initial cost that might be necessary to enable some manufacturing plants to make immediate use of it, this Board believes that at an early date the very large majority of these plants would avail themselves of its advantages. Also a large number of new industries would be attracted to the immediate territory traversed and connected, and these would naturally place themselves in immediate position to use the canal to the fullest extent.

In view of these facts it is the belief of this Board that, after a reasonable time, the traffic carried on this canal will bring a revenue sufficient to pay the cost and eventually to retire the bonds.

When this is accomplished, the question of reducing tolls to upkeep requirements only, and thus making the canal practically a free public highway, will be a matter for the people of the district to decide.

Another possibility to be considered in this connection is that the Federal Government, following its well-known policy of maintaining control of interstate waterways, may, at any time, take over this canal, retire its bonds and throw it open to the free use of the public.

AVAILABLE CANAL TONNAGE.

The total tonnage moved between the Ohio river and the lake front in 1914 has been estimated by Dean John T. Holdsworth at 308,261,633 tons. Of this tonnage bulky commodities amounted to 234,546,553 tons. These figures included all the tonnage moved in the district in which the canal will be situated.

Dr. Holdsworth further estimated that the bulky tonnage moved between the Ohio river and Lake Erie ports and shipped to and from the latter into or from the canal territory in 1913 was 116,778,000 tons. Of this he calculated 86,778,000 tons would be of a character that could advantageously use the canal.

The statistics for 1916 show that these figures were increased for that year to about 95,000,000 tons, of which about 38,000,000 tons were iron ore and 27,000,000 tons coal. The remaining 30,000,000 tons were made of coke, iron and steel products, limestone, sand, gravel, cement, brick and lumber. In 1923, the earliest date at which the canal could be opened, this tonnage would probably amount to not less than 130,000,000 tons.

To suggest the capacity of the canal and to indicate what may in the course of time be reasonably expected the Board submits the following estimates, which show in effect that with a traffic much less than its extreme capacity the canal can be operated at a profit and at the same time carry heavy freight at much lower cost than the railroads now do.

With an annual traffic of 19,000,000 tons, or one-half of the maximum capacity of the canal, the following would be the estimated revenue and expenditures, the rates figured upon being about one-half present railroad rates:

Revenue.

8,000,000 tons iron ore, at 31 cents per ton	\$2,480,000.00
7,000,000 tons coal, at 26 cents per ton..	1,820,000.00
4,000,000 tons miscellaneous freight, at 62 cents per ton.....	2,480,000.00
	<hr/> \$6,780,000.00

Expenditures.

Interest on \$65,000,000 at 4½%.....	\$2,925,000.00
Sinking Fund	2,166,666.66
Operation, maintenance and renewals..	758,333.34
	<hr/> 5,750,000.00
Balance.....	<hr/> \$1,030,000.00

This balance would be increased each year by the return or credit that would accrue either from the interest received on the investment of the sinking fund payments or from the reduction because of such payments of the amount of interest required to be raised for the outstanding bonded indebtedness.

TYPE AND SPEED OF BOATS.

The seventh question involves two matters of importance, one the type of boat to be used and the other the time required to load, unload and make a trip.

Naturally the final type of boat used will be decided by experience, but we now have the benefit of operations on the Monongahela and other rivers, and before our canal is completed will have knowledge of several years' operations on the New York-Erie Barge canal.

The Board has gone into this feature of the work at some length, and from information now at hand is of the opinion that the most practical and economical carriers that can be used will be barges of at least 1,100 tons capacity each, towed in fleets of three by tugs or towboats. Such fleets could move and pass freely and would each transport from 75 to 100 times as much bulk freight as an old-fashioned canal boat and about twice as much as a modern freight train of from 30 to 40 large cars. Self-propelled barges of much greater capacity than these are now being used successfully on various inland waterways in this country, and such barges can, of course, be operated on this canal if moved singly.

The Board is of the opinion that experience also will develop carriers of both types that can navigate between the Hudson and Mississippi rivers through this canal without breaking cargoes.

The Great Lakes steamers of large capacity are now compelled to unload their cargoes at docks for transfer to railroad. They can as conveniently and economically unload their cargoes into the canal fleet of barges as they can to the railroads. Conversely, transfer of coal from canal barges to lake steamers will be as cheap or cheaper than transfer from railroad to steamers.

As to the time of trips from Lake Erie to Pittsburgh, it is estimated that a self-propelled barge can make the trip in 57 hours, including about $9\frac{1}{2}$ hours for one loading at Pittsburgh and for one unloading at the lake. The return trip can be made in the same time. A barge fleet can make the trip in about $53\frac{1}{2}$ hours, the difference being largely due to the fact that in the case of the fleet there will be no detention for loading and unloading, the towboat only having to make up the small fleet of already loaded barges, and this, based upon experience, does not take over one hour at the two ports.

A three-barge fleet will carry on the round trip, occupying 107 hours, about 6,600 tons of coal and iron ore. The average speed of boats between locks will be about 6 miles per hour on the rivers about Pittsburgh, 5 miles on the Beaver and $4\frac{1}{4}$ miles on the Mahoning and in the canal proper. The barge fleet will travel about 62 miles a day, while the average movement of freight cars throughout the country is about 25 miles a day, and in the canal zone about 52 miles. The material carried by the canal will be largely of a non-perishable kind, and high speed, therefore, will be unnecessary. The boats may be expected to run more regularly and more closely to schedule than railroad freight cars, especially in times of unusual business activity.

AUTHORITIES.

Eighth: The authorities relied upon for the conclusions arrived at are as follows:

First:

The investigation made by the authority of the State of Pennsylvania in 1889 by a commission appointed by the Governor. On this commission there were well-known engineers, John M. Goodwin and Thomas P. Roberts, the latter for many years chief engineer of the Monongahela River Navigation Company. Ten thou-

sand dollars were expended. The report was favorable to a canal beginning at the mouth of the Beaver and following that river and the Shenango river to Greenville and thence to Conneaut on Lake Erie.

Second:

The investigation conducted in 1895-1896 by the Provisional Ship Canal Committee of the Chamber of Commerce of Pittsburgh, which expended \$50,000. Thomas P. Roberts was chief engineer of the Commission, and George M. Lehman, chief assistant in charge of the field and office work. Mr. Lehman had been chief assistant engineer in charge of surveys for the ship canal from the Delaware river to Raritan bay.

The other members of the commission were:

George A. Kelly, president; Simon Perkins, of Sharon, and ex-Governor A. B. Fleming, of West Virginia, vice presidents; John E. Shaw, secretary; John B. Jackson, treasurer; Charles W. Batchelor; John H. Ricketson; William S. Shallenberger, of Rochester, Assistant Postmaster General of the United States; H. C. Frick; Hon. Christopher L. Magee; Hon. William Flinn; A. J. Logan; William P. Herbert; E. M. Bigelow, civil engineer and Director of the Department of Public Works of Pittsburgh; Robert McAfee; J. R. Harrah, of Beaver; Joseph G. Butler, Jr., of Youngstown, Ohio; S. D. Warmcastle; James A. Henderson; Eugene M. O'Neill; Frank J. Hearne, of Wheeling; J. C. McDowell; James S. McKean; William H. Keech; William M. Kennedy; Eben Brewer, of Erie; Bernard McKenna; W. Harry Brown; W. L. Scaife, civil engineer; John F. Dravo; George C. Sturgis, of West Virginia; Thomas P. Roberts; S. H. Wilson; Morrison Foster; George H. Anderson; M. K. Moorhead; John A. Wood; D. P. Black; S. S. Marvin; William M. Brown; Alex. McClure, and John Eaton.

This Commission made a comprehensive and favorable report on all features of the canal. It approved of the route extending from the mouth of the Beaver and thence by that river and the Mahoning river to Niles, and thence by Mosquito creek to Ashtabula on Lake Erie.

It employed General Henry L. Abbot, member of the Technical Committee and consulting engineer for the Panama Canal Company and later member of the United States Government Board of Consulting Engineers to advise as to plan of Panama canal; Lewis N. Haupt, a member of the Nicaragua Canal Commission, and Major N. H. Hutton, for many years engineer of the harbor of Baltimore, to pass upon the work, and they approved the same.

Third:

The Lake Erie and Ohio River Ship Canal Company in 1905-1906 expended \$60,000 to investigate the canal. Its chief engineer was George M. Lehman, and he had as advisory engineers Emil Swensson and Thomas P. Roberts. They reported in favor of a canal along the same route as that reported by the Chamber of Commerce, except that the lake terminus was fixed at Indian creek instead of Ashtabula. They also indicated that there was an alternate route via Warren, terminating at the same place.

Fourth:

The National Waterways Commission investigated the canal project in the year 1912 and after receiving a favorable report from General W. H. Bixby, chief engineer of the United States Army, approved its construction on the lines indicated by the Lake Erie and Ohio River Canal Company's report.

Fifth:

Colonel H. C. Newcomer, United States engineer stationed at Pittsburgh, also made a favorable report on the canal at about the same time.

Sixth:

Colonel (now Major General) W. L. Sibert, lately a member of the Panama Canal Commission, in an address at the formation of the Lake Erie and Ohio River Canal Association in December, 1910, stated that he was thoroughly familiar with the canal project and that he believed it absolutely necessary, entirely feasible and calculated to prove profitable. Colonel Sibert was stationed at Pittsburgh for several years and during that time had an opportunity of investigating the matter.

Seventh:

The first Canal Board had as one of its members Colonel Thomas P. Symons, of the United States Army engineers and chief advisory engineer of the New York-Erie Barge canal. On his advice the Board selected as water supply expert, John P. Newton, and as engineer on construction and estimate work, George F. Stickney. Mr. Newton for twelve years was and now is hydraulic engineer for the New York-Erie Barge canal, and Mr. Stickney was for several years connected with the same project, supervising the construction of some of its most important sections, locks and dams. Their reports were satisfactory to Colonel Symons and were favorable to the canal project. Both Mr. Newton and Mr. Stickney were employed by the present Board. George M. Lehman was chief engineer for the first Canal Board.

Eighth:

The present Canal Board employed as its chief engineer, George M. Lehman. It was considered advisable by both the present Board and its predecessor to engage experts of unquestionable ability and of the highest standing to review the entire work, and they had the opportunity of availing themselves of the surveys and investigations conducted, upon several occasions, since 1895, by Mr. Lehman as to canal location and water supply, including sources, reservoirs and feeders. In pursuance of this idea the present Board, as has been heretofore stated, secured Isham Randolph to pass upon all data collected by it and by the first Board. Mr. Randolph was chief engineer of several railroads and also the chief engineer for the Chicago Drainage canal, which was constructed under his supervision. He was one of the five minority members of the International Board of Engineers whose report in favor of the lock canal at Panama was accepted by Congress and the President in preference to the majority of the Board favoring the sea-level canal. Mr. Randolph has also been engaged in the great project of draining the Florida Everglades. He has been president of the Western Engineers' Society and stands in the very front rank of his profession as a waterway expert. His report to the Board is emphatically in favor of the feasibility of the canal.

Ninth:

To secure the necessary data as to the economic features of the canal, the Board employed Dr. John T. Holdsworth, who, as has been previously stated, is Dean of the School of Economics of the University of Pittsburgh, who made an exhaustive study of the subject.

Tenth:

The reports of the Flood Commission of Pittsburgh which covered the important portion of the area from which the canal draws its chief water supply.

Eleventh:

The reports of the Pennsylvania State Water Supply Commission, especially the one made for it in February, 1917, by Frederic P. Stearns, member, as previously stated, of the United States Board of Consulting Engineers for the Panama Canal and of the Los Angeles Water Supply Commission.

Twelfth:

The reports of the United States Geodetic Survey and the United States Weather Bureau.

HOW THE CANAL MAY BE FINANCED.

The Pennsylvania law under which this Board has been conducting its investigations contains the following provision:

“The cost of the construction of such a canal or waterway and appurtenances shall be raised by such voluntary contributions, in money or in bonds at their par value, as have heretofore been made or as may hereafter be made, pursuant to the authority of any present or future laws of the United States, the State of Pennsylvania, the State of Ohio, the State of West Virginia and various counties, cities, towns, municipal corporations or other political sub-divisions of the States of Pennsylvania, Ohio and West Virginia, or by some or all of said United States and other public authorities.”

From this it is obvious that there are several ways in which the canal might be financed.

The fairest of these several ways would doubtless be for the United States, the States of Pennsylvania, Ohio and West Virginia and the counties of these three states directly affected all to join in making contributions on some equitable basis. But the difficulty of obtaining Federal and State aid to start projects of this kind is often so great that in the opinion of the Board the most practical plan is to first ask the counties to furnish the money.

There are 58 counties in Pennsylvania, Ohio and West Virginia that are reached directly by the canal or by the rivers whose waters connect with the canal. The assessed valuation of property in these counties is in round numbers \$5,200,000,000. The cost of the main line of the canal without branches is, as has been stated, \$65,000,000, which is about $1\frac{1}{4}\%$ of this assessed valuation of property. Adding the cost of the Warren and New Castle branches would slightly increase this percentage.

In almost all of these counties there are located large and important mining and manufacturing concerns which might logically be expected to be deeply interested in the construction of the canal.

It is the judgment of this Board that these counties could with propriety be asked to contribute in proportion to their tax valuation, and if so asked might be expected, in most cases at least, to act favorably when the advantages of the canal are fairly presented to the citizenship.

The percentage required of the counties under this plan would in no case be burdensome, and if, as is hoped, Federal and State aid could be obtained, such percentage would be very small.

This Board does not understand that it is part of its duty at this time to outline a definite plan of financing; the suggestions herein outlined are merely those which occur to it as most practical.

CONCLUSION.

In conclusion, the Board wishes to express its appreciation of the earnest, highly capable and sincere co-operation it has received from the eminent engineers who have been connected with the practical investigations of the questions it has had to attempt to answer. Members of the Board have given to their studies and findings their most careful consideration.

Before all the matters touched upon in this report are finally passed upon a great many questions not covered in it may be raised and for answers to these the Board refers to the voluminous and exhaustive reports covering every phase of the subject which have been made for it by the experts who have investigated the various physical and economic features of the canal.

The researches and conclusions of these authorities constitute a valuable fund of information which should be made generally available to the public at an early date.

(Signed) WILLIAM H. STEVENSON, *President*,
JOHN E. SHAW,
WILLIAM U. FOLLANSBEE,
THOMAS P. SLOAN,
A. E. ADAMS,
H. C. OGDEN.

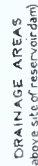
Attest:

BURD S. PATTERSON, *Secretary*.

June 21, 1917.

GENERAL MAP

A vertical scale bar labeled "Scale" with a "10 m" marker at the top.



French Creek	A	218
" "		
" "	(Bemus Dam)	
Cussetawago Creek	AA	694
Shenango River (Pymatuning Reservoir)	F	150
Pymatuning Creek	G	140
Mill Creek and Ashlaba River	I	50
Mosquito Creek (Proposed Lake)	J	95
Manhoning River	K	284
" "		257

Total area above sites now planned
" " " additional possible stor

